FLOOD

DEFINITIONS:

Flood – An inundation of dry land with water caused by weather phenomena and events that deliver more precipitation to a drainage basin than can be readily adsorbed or stored within the basin. Skagit County primarily experiences river flooding but is also subject to minor tidal flooding and surface flooding.

Flood Outlook – Issued by the National Weather Service as an initial notice of a potential hazardous flooding event. The flood outlook raises public awareness of the possibility of a severe flooding event. A Flood Outlook is issued 72 to 36 hours before the occurrence of the event.

Flood Watch – Issued by the National Weather Service when the probability of a hazardous flooding event has increased significantly but its occurrence, location, or timing is still uncertain. The public can set their plans in motion to prepare for the event. A Flood Watch is issued from 36 to 12 hours before the occurrence of the event.

Flood Warning – Issued by the National Weather Service when a hazardous flooding event is occurring, is imminent, or has a high probability of occurrence within 12 hours. A Flood Warning is issued for conditions posing a threat to life and/or property.

Flood Stage – A height at which a watercourse overtops its banks and begins to cause damage to any portion of the river valley.

Floodplain – The land area of a river valley that becomes inundated with water during a flood.

Floodway – That portion of the natural floodplain that is regularly inundated during the normal annual flood cycles of a river or stream. For most waterways, the floodway is where the water is likely to be deepest and fastest. It is the area of the floodplain that should be kept free of obstructions to allow floodwaters to move downstream.

100-Year Floodplain – That portion of the floodplain that would be inundated by water during a 100-Year Flood event.

500-Year Floodplain – that portion of the floodplain that would be inundated by water during a 500-Year Flood event.

National Flood Insurance Program (NFIP) – A Federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the Federal Government which states if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas, the

Federal Government will make flood insurance available within the community as a financial protection against flood losses.

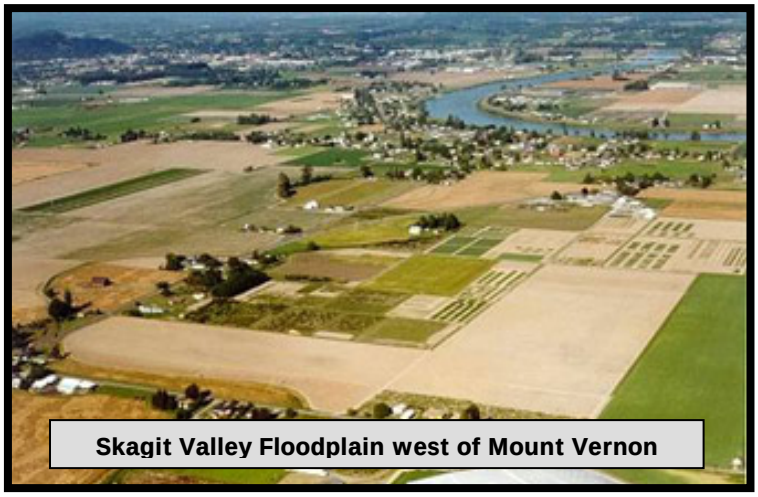
Community Rating System (CRS) – A voluntary program within the NFIP that encourages and recognizes community floodplain management activities that exceed the minimum NFIP standards for local mitigation, outreach, and education. Under the CRS, flood insurance rates are adjusted to reflect the reduced flood risk resulting from community activities that reduce flood losses, facilitate accurate insurance rating, and promote the awareness of flood insurance.

BACKGROUND INFORMATION:

Except severe storms, floods are the most common of natural disasters that occur in Skagit County; the Federal Emergency Management Agency (FEMA) considers the Skagit River "potentially the most damaging river in the state".

River Flooding occurs on rivers and streams when excessive water discharge causes river or stream channels to overflow. The Skagit River, Samish River, Sauk River, Suiattle River, and Cascade River as well as many other smaller streams in Skagit County are all susceptible to river flooding.

Floods in the Skagit Basin can be classified as either spring snowmelt or winter rain on snow events. The threat of flooding in Skagit County is greatest in the months of November, December, January, and February although flood events have also occurred during other months of the year. Winter flood events have the potential to produce the highest peak flows when significant low elevation snowfall is present, followed by rising freezing levels, heavy rain, and wind. In addition, high tides that occur during a flood event further increase the potential of flooding due to their restricting effect on river discharge flows.


Skagit Valley Floodplain west of Mount Vernon

Based on discharge flows of rivers that empty into salt-water, the Skagit River is the third largest river system on the West Coast of the contiguous United States with only the Columbia River and the Sacramento River being larger.

From its source in Canada, the Skagit River flows 135 miles and empties into Skagit Bay. The river drains an area of approximately 3,115 square miles. The source starts at an elevation of 8,000 feet and drops to an elevation of 1,600 feet at the Canada-United States border. Three major tributaries empty into the Skagit River within Skagit County thereby significantly increasing the Skagit's flow. These rivers are the Cascade River, the Sauk River, and the Baker River. Several small watersheds are also tributary to the Skagit; these include Illabot Creek, Finney Creek, Day Creek, and Noockachamps Creek watersheds. In addition, many small feeder streams also discharge directly into the Skagit.

From Concrete to Sedro-Woolley, the river valley varies from 1 to 3 miles in width bordered by steeply rising timbered hills. Below Sedro-Woolley, the valley descends to nearly sea level and widens to a flat, fertile floodplain (approximately 90,000 acres in total area with 68,000 acres of this area located downstream of Sedro-Woolley) that joins the Samish Valley to the north and extends west through Mount Vernon to La Conner and south to the Stillaguamish River. During extremely large flood events, the Skagit River sometimes overflows the low divide between the Skagit River and the Samish River and enters the Samish River Basin. At Fir Island, the Skagit divides into the North Fork (carrying about 60% of the discharge flow) and the South Fork (carrying about 40% of the discharge flow).

Levee and dike building in Skagit Valley started in the late 1800's with pick, shovel, and wheelbarrows and today has progressed to excavators and dump trucks. Over the years there have been numerous floods and levee breaks followed by new levee construction projects to build the levees higher and wider thereby hoping to contain and control the mighty Skagit. Currently, there are about 56 miles of river levees and 40 miles of salt-water dikes in Skagit County. These levees and dikes are managed by Dike Districts with each district governed by a Board of Commissioners. There are currently 12 separate dike districts within Skagit County. The Districts have broad powers and responsibilities including the protection of lives and property located within their district.

The United States Army Corps of Engineers inspects the Skagit River levees on an annual basis to insure they meet established standards. The Skagit River levee system is constructed to control an event that falls within the 25-year flood to 35-year flood range with a river gauge height of 38 feet and a flow of 140,000 to 155,000 cubic feet per second. In comparison, the Skagit River gauge height averages 10 feet to 14 feet in the summer months and 15 feet to 18 feet in the winter months. **Flood Stage corresponds to a gauge height of 28 feet.**

Dam construction in the Skagit Basin began in 1924 with the Low Gorge Dam and continued until 1961. All of these dams were designed and built as hydropower generation structures. However, as the magnitude of Skagit Basin flooding problems became more evident, flood control storage was later required in the Ross and Upper Baker Reservoirs. No flood control storage is required in Diablo, Gorge, or Lower Baker Reservoirs.

Dam Construction and Related Flood Control Storage Requirements
(Information obtained from Seattle City Light, Puget Sound Energy, and U.S.A.C.E.)

Year	Significant Construction or Flood Control Event
1924	Low Gorge Dam completed
1925	Lower Baker Dam completed
1929	Diablo Dam completed
1940	Ross Dam (1st step) completed
1946	Ross Dam (2nd step) completed
1949	Ross Dam (3rd step) completed
1954	120,000 acre-feet of flood storage required in Ross Reservoir by FERC license
1956	16,000 acre-feet of flood storage required in Upper Baker Reservoir by FERC license
1959	Upper Baker Dam completed
1961	High Gorge Dam completed
1977	58,000 acre-feet of flood storage in Upper Baker Reservoir authorized by Congress

During major flood events, the United States Army Corps of Engineers takes over control of the Upper Baker Dam and the Ross Dam to maximize flood storage capacity and regulate the release of water in an attempt to minimize the impacts of the event to those areas located downstream. The United States Army Corps of Engineers typically takes control of the Upper Baker Dam and the Ross Dam under the following circumstances:

1. When there is a forecast of a natural flow of 90,000 cubic feet per second at Concrete.
2. Either dam raises their pool elevation enough to encroach within the designated flood control storage space.

In the event of a predicted flood, the Corps takes control 8 hours prior to the forecasted time of peak flow arrival at Concrete and relinquishes control when the natural flow volume reaches 62,500 cubic feet per second. Depending upon other circumstances, the Corps may retain control of the dams as the situation dictates in order to accommodate response and/or recovery efforts that may be occurring downstream.

In the event the Corps takes control of the dams because of an elevated pool height, the Corps will retain control of the dam until the owner of the dam has evacuated all water above the flood control pool. (For additional information regarding this issue, please refer to the United States Army Corps of Engineers Water Control Manual, Skagit River Project, Skagit River, Washington.)

The United States Army Corps of Engineers controlled these dams during the 1990 floods (two events) and the 1995 floods (two events) thereby significantly reducing peak flow rates and flood damage to government infrastructure and private property in the lower Skagit River Basin.

HISTORY:

The Skagit River has a long, well-documented history of flood events – several recent flood events have resulted in Presidential Disaster Declarations.

While there were many large flood events during the late 1800's and early 1900's with peak flow rates varying between 180,000 cubic feet per second and 210,000 cubic feet per second, recent events have been notably smaller with peak flow rates of 152,000 cubic feet per second in 1990 and 151,000 cubic feet per second in 1995.

The differences in peak flow rates between these time periods is most likely attributable to the flood storage provided by the Ross Reservoir and the Upper Baker Reservoir as well as the regulating of water released from these reservoirs by the United States Army Corps of Engineers during flood events.

The 1975 flood event served as a "wake-up call" to all Skagit County residents and governmental agencies that the Skagit River posed a significant flood threat to the residents and businesses located within the floodplain and that we could not rely on a levee system to protect us from all flooding events. The 1975 flood caused considerable public damage to transportation systems, the river levee system and wastewater disposal and drainage systems as well as private damage to homes, businesses and the local agricultural community. Following the 1975 flood, there was a concerted effort by local dike districts and other government

agencies to raise and reinforce existing levees as well as increase flood awareness and public education regarding the flood risk in Skagit County.

The 1990 floods (two events) and the 1995 floods (two events) were the largest floods to impact Skagit County since the completion of the hydropower dams on the upper Skagit and the Baker River. The 1990 floods and the 1995 floods both involved an initial flood peak occurring on or near Veterans Day followed by a second flood peak occurring on or near Thanksgiving Day.

The 1990 floods caused major flooding in the Town of Hamilton as well as many other low-lying areas of Skagit County. In addition, a failure of the levee on Fir Island forcing an emergency evacuation of all residents of Fir Island as well as more than 1,200 head of cattle. Fir Island was inundated with water up to 8 feet in depth flooding almost all of the homes on the island and damaging agricultural land and crops. Before the water receded, unusually cold temperatures caused the floodwaters to freeze for almost two weeks causing further damage to many homes. Approximately 8,000 acres of farmland was damaged due to floodwaters and flood debris. In some areas, farmland was covered with up to 3 feet of sand and silt.

For several months following the 1990 flood event, farmers and residents of the island were assisted in their efforts to remove debris and clean their homes by a large and well organized volunteer effort spearheaded by local and regional religious groups.

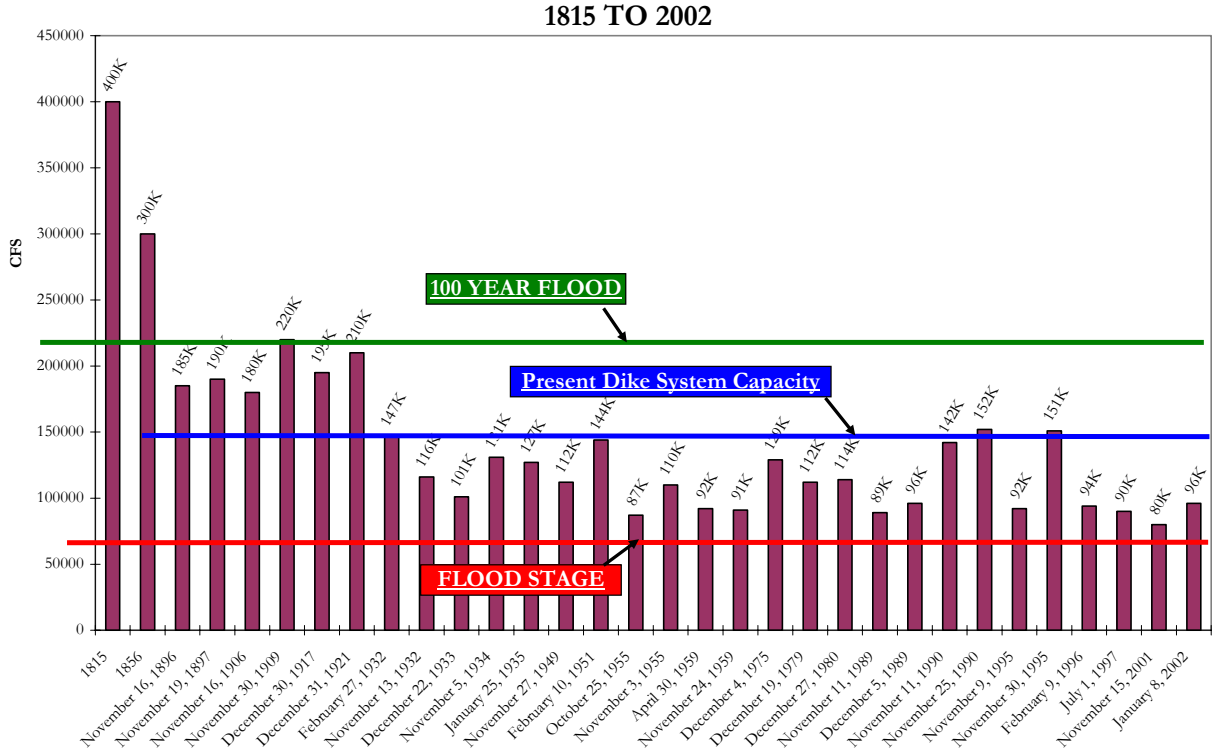
The City of Mount Vernon, the City of Burlington, and other areas within the floodplain were saved from serious flooding only because of an extensive and organized flood-fight effort carried out by the Skagit County Public Works Department, the United States Army Corps of Engineers, numerous local dike districts and fire departments as well as hundreds of volunteers and members of the Washington Military Department.

FIR ISLAND – 1990
(Skagit County Public Works Department Photo)

While the 1995 floods had almost the same peak flows as the 1990 floods, there was less damage from these floods because of the extensive work done to the levee system following the 1990 floods as well as the aggressive and sustained flood-fight efforts on the part of the dike districts and other governmental agencies to prevent a levee failure like the one on Fir Island in 1990.

SKAGIT RIVER RECORDED DISCHARGES

1815 TO 2002



(The above information was obtained from the Skagit County Public Works Department)

Recent Skagit River Flood Events Resulting in Presidential Disaster Declaration (Information obtained from Skagit County Department of Emergency Management files)				
Incident Date	Disaster Number	Concrete Gauge	Maximum Flow (cubic feet/second)	Estimated Damage
Dec. 1975	492	35.6 Feet	129,000 cf/s	$365.808
Dec. 1979	612	34.0 Feet	112,000 cf/s	$3,341,000
Nov. 1990	883	40.2 Feet	142,000 cf/s	$36,381,228 (for both events)
Nov. 1990	883	39.89 Feet	152,000 cf/s	
Nov. 1995	1079	39.34 Feet	92,000 cf/s	$14,539,982 (for both events)
Nov. 1995	1079	41.57 Feet	151,000 cf/s	
Feb. 1996	1100	32.11 Feet	94,000 cf/s	$1,167,783

NOTE:

1. Flood stage at Mount Vernon is 28 feet (North American Vertical Datum 1929)
2. Flow rates are listed in Cubic Feet per Second as taken near Concrete
3. Recurrence Intervals are based on there being a 1% chance each year of a 100-year flood event occurring; a 2% chance each year of a 50-year flood event occurring; a 4% chance each year of a 25-year flood occurring, and so forth
4. Damage figures listed are in year of occurrence dollars

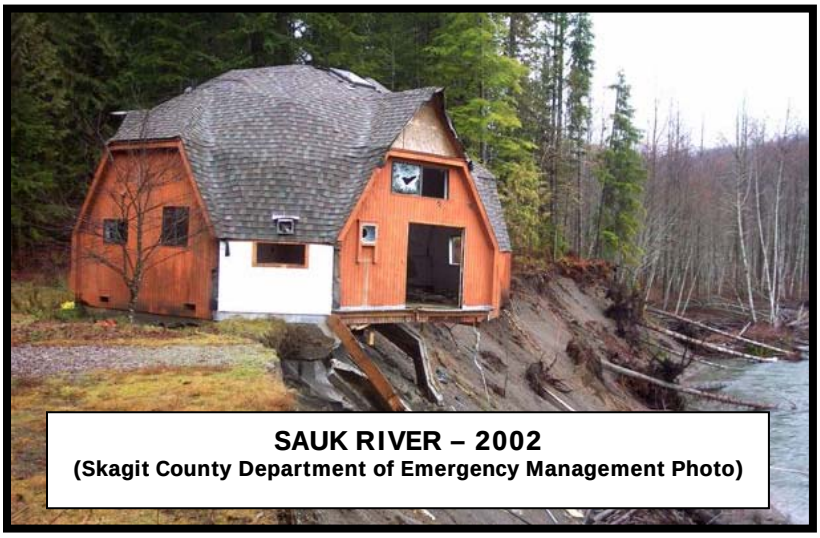
HAZARD IDENTIFICATION:

While the levee system on the Skagit River has controlled much of the flood threat within the lower delta, these levees have also contributed to the vulnerability of the citizens and business of the county. Without the levees, minor flooding would occur on almost an annual basis, sometimes occurring more than once each year. The "inconvenience" of frequent minor flooding would have most likely encouraged residential and commercial development to be located on higher ground and out of flood hazard areas.

With the levees in place, the "inconvenience" of minor flood events has been minimized except in those low-lying areas upstream of the levee system and the residents and business owners of Skagit County have perhaps gained a false sense of security in the levee system - they may mistakenly assume that the levees will protect them from all floods in addition to the smaller, more frequent events. It should be noted that approximately 30,000 people or about 28% of the population of Skagit County live within the floodway and the floodplain of the Skagit River.

Due to the large amount of commercial and industrial development that is located in the lower valley floodplain, the majority of our transportation and communication infrastructure has also been located in the floodplain in order to serve the needs of the ever-growing community. A major Skagit River flood event that causes large portions of the valley to be inundated with water has the potential to severely impact the overall economy of Skagit County as well as other communities within the North Puget Sound region.

While the Skagit River poses a major flood threat in the lower valley, the Sauk River and Suiattle River (located in the upper valley) also pose a significant threat of their own. These streams do not have levee systems and have a history of changing their channels and eroding their banks during flood events. Because of the *WILD AND SCENIC RIVER* designation, government entities and private property owners are not allowed to place rip-rap or any other type of material along these river banks to mitigate these channel changes and bank erosion. In areas where erosion is severe or drastic channel changes occur, homes and property are many times simply "lost" to the river.



SAUK RIVER – 2002
(Skagit County Department of Emergency Management Photo)

The severity of flood damage is dependent upon ground elevation, the surrounding topography, peak flow volumes, surface flow velocities, and proximity to the river or a levee break. Major channel changes are usually associated with high flow volumes, especially in areas characterized by flat, broad floodplains such as the lower Skagit Valley.

The following list of problems includes information contained in the United States Army Corps of Engineers Skagit River Flood Damage Reduction Feasibility Study as well as comments and suggestions made by various stakeholders and the public.

In addition to damaging homes, businesses, property, and the environment, a 100-year flood event in Skagit County could potentially result in the following:

- Portions of Interstate 5, State Route 9, State Route 11, State Route 20, State Route 536 and possibly portions of State Route 530 would be inundated and impassable to traffic.

  [As part of the research conducted in August, 2001 to compile the United States Army Corps of Engineers Skagit River Flood Damage Reduction Feasibility Study, it was found that Interstate 5 is utilized by approximately 65,000 vehicles a day in Skagit County and approximately 23,000 daily commuter trips via State Route 20 occur between Fidalgo Island and the I-5 corridor. This study concluded that highway closures and resulting traffic delays due to a Skagit River 100-year flood event are estimated to cost over $15,000,000 per flood event.]

- The Anacortes Water Treatment Plant could be inoperable for up to 45 days or perhaps longer. This facility serves the City of Anacortes, the Town of La Conner, portions of Fidalgo Island, as well as the Shell and Tesoro refineries in addition to the City of Oak Harbor and Naval Air Station Whidbey Island located in Island County.

- All municipal wastewater treatment facilities as well as major storm water pumping systems could be inoperable for up to 45 days of perhaps longer.

- The economy of the entire county could be devastated. According to United States Army Corp of Engineers estimates, damages could exceed $1 billion dollars locally per 100-year flood event. Road, railroad and pipeline transportation to the refineries would be in jeopardy forcing shutdowns for an industry employing more than 800 workers with annual payrolls exceeding $57 million and thousands of people would possibly be unable to commute from their homes to work. According to the Washington State Office of Trade and Economic Development, exports to Canada are worth approximately $6.6 billion and overland imports exceed $14.3 billion annually; approximately 95% of all commercial goods between British Columbia and Washington are shipped overland, most of them via the I-5 corridor.

- In general, a 100-year flood event would create a wide variety of problems very similar to a large, damage-causing earthquake. Transportation routes and utilities will be greatly affected, local first response agencies will be totally overwhelmed and many personnel may not be able to report for duty as they may be personally affected by the incident and many shelter sites will be unusable due to their location in the floodplain. Health and environmental issues will result due to contaminated floodwaters, contaminated wells, hazardous materials and farm chemicals released into floodwaters, and dead animals.

- Evacuation efforts throughout the floodplain will require special considerations due to the fact that large numbers of dairy cattle will need to be evacuated from numerous

farms in addition to the approximately 30,000 people that live in the floodplain. In 1990, over 1,200 dairy cows were transported off of Fir Island and relocated to various dairies in Skagit and Snohomish counties.

- Recovery efforts will focus on re-opening and/or re-building transportation routes, re-establishing essential facilities and governmental services, clearing debris, cleaning and decontaminating homes, businesses, and farm buildings, and re-construction of levees.

VULNERABILITY ASSESSMENT:

As mentioned earlier, the Skagit River is the third largest river system on the West Coast of the contiguous United States based on discharge flows of rivers that empty into salt-water. All persons, property, and businesses located within the floodway and the floodplain of the Skagit River are directly vulnerable to flooding. In addition, the overall economy of Skagit County is directly or indirectly vulnerable to major flood events.

In the past, those mainly affected by flooding were the farm families that lived in the lower portions of the valley and the crops and dairy herds they raised. With the dramatic increases in population and commercial development in the western portion of Skagit County that have occurred in recent years, the effects of a major flood event could be long-term and very difficult to overcome.

With a large increase in commercial and/or industrial development and the requirement that these structures be elevated above the existing floodplain, surface water flows may be altered or diverted from their normal locations thereby causing increased flooding in certain areas that may have previously had little vulnerability to flooding.

After the 1990 and 1995 flood events, there was a renewed interest in providing additional flood protection for the lower valley. As a result, the United States Army Corps of Engineers (USACE) and Skagit County conducted the United States Army Corps of Engineers Skagit River Flood Damage Reduction Feasibility Study.

As part of the United States Army Corps of Engineers Skagit River Flood Damage Reduction Feasibility Study, the USACE produced a Draft Baseline Economic Report in December 2002. This report contains detailed information regarding the potential losses due to flood events of various severity based upon an extensive economic review of the lower valley.

The study area was divided into six reaches (areas) for analysis based on their engineering and economic similarities. Land use was inventoried for the area likely to be inundated for flood events of differing severity up to a 500-year flood event. The data was collected during the first half of Federal Fiscal Year 2000.

A complete field survey of all commercial and industrial structures located in the floodplain was undertaken. Residential structures were surveyed through a random sample of the floodplain. The data collected included structure use, type of construction, structure size, condition, and first-floor elevation. A hand level was used to estimate elevations above ground level. Structure values were based on depreciated replacement value.

In addition to the residential and non-residential structure inventory, the USACE also calculated agricultural damages, transportation delays and costs due to the closure of Interstate 5. The study also includes several critical facilities such as water treatment and wastewater treatment facilities located within the floodplain.

The USACE Draft Baseline Economic Report did not include short-term or long-term economic damage for business and industry located in the floodplain or business and industry that could be affected due to the closure of that portion of State Route 20 located west of Burlington.

PROBABLITY AND RISK:

Based upon the historical record of flooding in the Skagit River Basin and the severe impacts large flood events have had on the citizens of Skagit County, there is a **high probability** of future flooding and a **high flood risk** for the people, businesses, and infrastructure located within the floodway and the floodplain of the Skagit River.

The following statement is from the summary section of the United States Army Corps of Engineers Skagit River Flood Damage Reduction Feasibility Study.

> *Under existing conditions, flooding is a serious and frequently occurring problem for the Skagit River basin. Over 12,000 structures are at risk of flooding with a total property value (structure and content) exceeding $2.8 billion. Potential total losses from a single flood event could be as great as $1.4 billion. Based on study results, expected annual damages to property and associated losses would be nearly $42.7 million with direct residential damages accounting for nearly 60% of the losses. These damage figures, coupled with the damages expected to occur to agriculture, and the delay costs due to closure of Interstate 5 raise the expected annual damages to a level reaching $45.6 million (not including short-term and long-term economic damages). While the magnitude of damages is one concern, the long-term risk for flooding is another. The risk of flooding at least once during a 10 year period exceeds 50% for all but two of the study reaches, with one of these two (Reach 4) at virtually 50%. Based on the annual exceedance probabilities, there is a greater than 1 in 10 chance of flooding in any given year for all but two reaches (with Reach 6 having the greatest risk at 1 in 6). Both the highly expected annual damages and high probability of flooding indicate that the existing flood risk should be reduced.*

CONCLUSION:

In Skagit County, floods are a major threat to property and the environment, and to a lesser extent, the safety of persons and livestock located within the floodway and the floodplain. Flood damages in Skagit County exceed losses due to all other natural hazards.

The citizens of Skagit County need to have an understanding of the flood risk and of the areas in which they elect to live and do business. **Citizens need to know what the terms FLOOD WATCH and FLOOD WARNING mean**. They need to familiarize themselves with local river-

level gauge readings and at what river-level gauge reading their property is impacted. They need to know that the existing levee system will not protect their property from all flood events.

Those persons that choose to live and/or work in a flood hazard area need to recognize that government is not able to totally protect them from the impacts of a flood. Those people at risk need to take the necessary actions to prepare themselves, their families, and their businesses before a flood event – not after.

Skagit County participates in the National Flood Insurance Program. Persons buying homes in the floodway and/or the 100-year flood plain are almost always required to purchase flood insurance as a condition of financing; however, there is no requirement that all residential structures purchase flood insurance if not required by a lending institution. In addition, many businesses located within the 100-year floodplain also purchase flood insurance.

Skagit County as well as the municipalities of Burlington, La Conner, and Mount Vernon also participate in the National Flood Insurance Program Community Rating System in an effort to provide flood mitigation activities and lower flood insurance premiums for those property owners who live within their jurisdictions and purchase flood insurance.

Warning and evacuation of flood-prone areas has improved significantly in the past 25 years. River flow gauging systems jointly operated by the United Stated Geological Survey and Skagit County provide the National Weather Service, the River Forecast Center, and Skagit County Government with up-to-date river levels greatly increasing the ability to predict flood events on the Skagit River. The timeliness of these predictions, as well as the familiarity of local agencies as to their roles and responsibilities, significantly improves the county's preparedness level for flood events. During a flood event, every attempt is made to insure that flood warning information is disseminated as widely as possible. In addition, 24-hour flood information is available via telephone and the Internet to aid citizen access to flood information. This information includes river-level gauge readings that are updated on a regular basis during flood emergencies.

About 30% of Skagit County residents live in the floodplain including the cities/towns of Burlington, La Conner, Mount Vernon and Sedro-Woolley and the number of persons living within the floodplain will no doubt continue to increase as the population of the county continues to increase.

Due to the size of the Skagit River and its floodplain and the location of large population centers, critical facilities, governmental services, and major transportation routes relative to the floodplain, the devastation caused by a 50-year or 100-year Skagit River flood event will most likely directly or indirectly affect almost all Skagit County residents.

It should be noted that the United States Army Corps of Engineers Skagit River Flood Damage Reduction Feasibility Study as well as the associated Draft Baseline Economic Report are currently being revised due to recent upgrades made to the Skagit River levee system. The flood-related information contained in this plan is the result of the best data available at the time of printing.